DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. _____; Notice No. -___]

RIN: 2120-_____

Revised General Function and Installation Requirements for Equipment, Systems, and Installations on Transport Category Airplanes.

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: In this action, the FAA proposes to revise certain current airworthiness standards pertaining to the function and installation of equipment, systems, and installations on transport category airplanes. This action also would revise and clarify the related standards pertaining to powerplant installations. In effect, this action would reduce certain testing and analysis requirements for equipment, systems, and installations that have no effect on airplane safety. It also would clarify the intent and applicability of the affected rules. The changes proposed in this action were developed in cooperation with the Joint Aviation Authorities (JAA) of Europe and the Aviation Rulemaking Advisory Committee (ARAC). They are intended to achieve common requirements between the U.S. regulations and the Joint Aviation Requirements (JAR) of Europe while maintaining or improving the level of safety provided by the current regulations. This action is necessary to assure consistent and effective application of the affected FAA and JAA regulations.

DATES: Send your comments on or before [Insert date 90 days after date of publication in the Federal Register.]

ADDRESSES: Address your comments to the Docket Management System, U.S. Department of Transportation, Room Plaza 401, 400 Seventh Street, SW., Washington,

DC 20590-0001. You must identify the docket number XXXXX at the beginning of your comments, and you should submit two copies of your comments. If you wish to receive confirmation that FAA received your comments, include a self-addressed, stamped postcard.

You may also submit comments through the Internet to http://dms.dot.gov . You may review the public docket containing comments to these proposed regulations in person in the Dockets Office between 9:00 a.m. and 5:00 p.m., Monday through Friday, except Federal holidays. The Dockets Office is on the plaza level of the NASSIF Building at the Department of Transportation at the above address. Also, you may review public dockets on the Internet at http://dms.dot.gov.

FOR FURTHER INFORMATION CONTACT: Linh Le, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, FAA, Northwest Mountain Region, 1601 Lind Avenue S.W., Renton, Washington 98055-4056; telephone (425) 227-1105; fax (425) 227-1320; e-mail linh.le@faa.gov.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the making of the proposed action by submitting such written data, views, or arguments, as they may desire. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this document are also invited. Substantive comments should be accompanied by cost estimates. Comments must identify the regulatory docket or notice number and be submitted in duplicate to the DOT Rules Docket address specified above.

All comments received, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking, will be filed in the

docket. The docket is available for public inspection before and after the comment closing date.

We will consider all comments received on or before the closing date before taking action on this proposed rulemaking. Comments filed late will be considered as far as possible without incurring expense or delay. The proposals in this document may be changed in light of the comments received.

Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this document must include a pre-addressed, stamped postcard with those comments on which the following statement is made: "Comments to Docket No. _____." The postcard will be date-stamped and mailed to the commenter.

Availability of Rulemaking Documents

You can get an electronic copy using the Internet by taking the following steps:

(1) Go to the search function of the Department of Transportation's electronic Docket Management System (DMS) web page (http://dms.dot.gov/search).

(2) On the search page type in the last four digits of the Docket number shown at the beginning of this notice. Click on "search."

(3) On the next page, which contains the Docket summary information for the Docket you selected, click on the document number of the item you wish to view.

You can also get an electronic copy using the Internet through FAA's web page at http://www.faa.gov/avr/arm/nprm/nprm.htm or the Federal Register's web page at http://www.access.gpo.gov/su_docs/aces/aces140.html.

You also can get a copy by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267-9680. Make sure to identify the docket number, notice number, or amendment number of this rulemaking.

BACKGROUND

The Airworthiness Standards of the U.S. and Europe

The airworthiness standards for transport category airplanes are contained in Title 14, Code of Federal Regulations (14 CFR) part 25 [commonly referred to as part 25 of the Federal Aviation Regulations (FAR)]. Manufacturers of transport category airplanes must show that each airplane they produce of a different type design complies with the relevant standards of part 25. These standards apply to airplanes manufactured within the U.S. for use by U.S.-registered operators, and to airplanes manufactured in other countries and imported to the U.S. under a bilateral airworthiness agreement.

In Europe, the Joint Aviation Requirements (JAR) were developed by the Joint Aviation Authorities (JAA) to provide a common set of airworthiness standards for use within the European aviation community. The airworthiness standards for European type certification of transport category airplanes are contained in JAR-25, and are based on 14 CFR part 25. Airplanes certificated to the JAR-25 standards, including airplanes manufactured in the U.S. for export to Europe, receive type certificates that are accepted by the aircraft certification authorities of 26 European member countries.

"Harmonization" of U.S. and European Standards

Although part 25 and JAR-25 are very similar, they are not identical in every respect. Differences between these two sets of standards can result in substantial additional costs when airplanes are type certificated to both standards. These additional costs, however, frequently do not bring about an increase in safety. For example, part 25 and JAR-25 may use different means to accomplish the same safety intent. In this case, the manufacturer is usually burdened with meeting both requirements, although the level of safety is not increased correspondingly. Recognizing that a common set of standards would not only economically benefit the aviation industry, but also would maintain the necessary high level of safety, the FAA and JAA consider "harmonization" of the two sets of standards to be a high priority.

In 1988, the FAA, in cooperation with the JAA and other organizations representing the American and European aerospace industries, began a process to harmonize the airworthiness requirements of the United States and the airworthiness requirements of Europe, especially in the areas of Flight Test and Structures. The FAA's harmonization effort was formally initiated in 1991 with the establishment of the Aviation Rulemaking Advisory Committee (ARAC), described in detail below.

The Aviation Rulemaking Advisory Committee (ARAC)

The FAA formally established ARAC on January 22, 1991 (56 FR 2190), to provide advice and recommendations concerning the full range of the FAA's safety-related rulemaking activity. This advice was sought to develop better regulations in less overall time using fewer FAA resources than were historically needed. The committee provides the opportunity for the FAA to obtain firsthand information and insight from interested parties regarding potential new rules or revisions of existing rules.

There are 64 member organizations on the committee, representing a wide range of interests within the aviation community. Meetings of the committee are open to the public, except as authorized by section 10(d) of the Federal Advisory Committee Act.

The FAA assigns specific tasks to ARAC, which are published in the Federal Register. The ARAC then establishes Working Groups to develop proposals to recommend to the FAA for addressing the assigned tasks. Although Working Group meetings are not generally open to the public, all interested parties are invited to participate as working group members. Working groups report directly to the ARAC, and the ARAC must accept a working group proposal before that proposal can be presented to the FAA as an advisory committee recommendation.

The activities of the ARAC will not, however, circumvent the public rulemaking procedures. After an ARAC recommendation is received and found acceptable by the

FAA, the agency proceeds with the normal public rulemaking procedures. Any ARAC participation in a rulemaking package will be fully disclosed in the public docket.

Working Groups Tasked by ARAC

The ARAC held its first meeting on May 3, 1991 (56 FR 20492, May 3, 1991). The Transport Airplane and Engine Subcommittee (later renamed the Transport Airplane and Engine Issues Group, TAEIG) was established at that meeting to provide advice and recommendations to the Director of the FAA's Aircraft Certification Service on the airworthiness standards for transport airplanes, engines, and propellers in 14 CFR parts 25, 33 and 35.

By notices in the Federal Register (57 FR 58845, December 11, 1992; and 58 FR 13819, March 15, 1993), the TAEIG established:

- the Installation Harmonization Working Group (later renamed the Power Plant Installation Harmonization Working Group, PPIHWG) and
- the System Design and Analysis Harmonization Working Group (SDAHWG).

The TAEIG tasked these two Working Groups with developing recommendations concerning new or revised rules and policies associated with the assessment of aircraft and powerplant systems safety, and to harmonize these part 25 rules with the parallel JARs.

This NPRM is based on the proposals developed by the Working Groups and submitted by ARAC to the FAA as recommendations to achieve harmonization of the system design and analysis requirements of subparts E and F of part 25 with JAR-25. At the time that the PPIHWG and SDAHWG began their work on this harmonization effort, some standards were already in the process of revision and improvement by the FAA in conjunction with aviation industry committees, including the Society of Automotive Engineers (SAE), the Radio Technical Commission For Aeronautics (RTCA), Inc., and

EUROCAE. The necessary revisions that were identified by those groups have been included in this NPRM.

DISCUSSION OF THE PROPOSAL

With this NPRM, the FAA proposes changes to the general function and installation requirements and the system design and analysis requirements of subpart F of part 25, as well as related changes to the powerplant installation requirements of subpart E. These proposed changes were identified as part of the activities associated with the ARAC task to harmonize:

- § 25.901(c) ("Powerplant, General -- Installation"),
- § 25.1301 ("Equipment, General -- Function and installation"), and
- § 25.1309 ("Equipment, systems, and installations").

The primary basis for the proposed changes relates to the requirements currently contained in § 25.1309(a) and (b), which state:

"(a) The equipment, systems, and installations whose functioning is required by this subchapter, must be designed to ensure that they perform their intended functions under any foreseeable operating condition.

(b) The airplane systems and associated components, considered separately and in relation to other systems, must be designed so that--

(1) The occurrence of any failure condition which would prevent the continued safe flight and landing of the airplane is extremely improbable, and

(2) The occurrence of any other failure conditions which would reduce the capability of the airplane or the

ability of the crew to cope with adverse operating conditions is improbable."

As currently stated, these requirements have posed certain problems to the certification of transport category airplanes, which are discussed at length below. The FAA is proposing revisions to several related standards that it considers necessary in order to eliminate such problems and to clarify the intent of these standards. A detailed discussion of each proposed change follows.

Definitions Used in this NPRM

For the purposes of this NPRM, the following definitions apply:

Catastrophic Failure Condition: a failure condition that would result in multiple fatalities, usually with the loss of the airplane. (**NOTE**: This term was defined differently in previous versions of § 25.1309 and accompanying advisory material -- as "a failure condition that would prevent continued safe flight and landing.")

Error: an omission or incorrect action by a crewmember or maintenance personnel, or a mistake in requirements, design, or implementation.

Event: an occurrence that has its origin distinct from the airplane, such as atmospheric conditions (e.g., gusts, temperature variations, icing, and lightning strikes); runway conditions; conditions of communication, navigation, and surveillance services; bird-strike; cabin and baggage fires; etc. The term does not cover sabotage.

Extremely Improbable Failure Condition: a failure condition that is so unlikely that it is not anticipated to occur during the entire operational life of all airplanes of one type. [**NOTE**: See related section entitled "Proposed changes to §25.1309(b)" elsewhere in this NPRM for more information regarding the background and intent of the term "extremely improbable."]

Extremely Remote Failure Condition: a failure condition that is not anticipated to occur to each airplane during its total life, but which may occur a few times when considering the total operational life of all airplanes of the type. [**NOTE**: The term "extremely remote" has been used previously within 14 CFR part 25 to describe a condition so remote that it is not anticipated to occur in service on any transport category airplane (i.e., "extremely improbable"). However, for the purposes of this proposed regulation, the term "extremely remote" will have the meaning specified above.]

Failure: an occurrence that affects the operation of a component, part, or element such that it can no longer function as intended (this includes both loss of function and

malfunction). (**NOTE**: Errors and events may cause failures or influence their effects, but are not considered to be failures.).

Failure Condition: a condition, caused or contributed to by one or more failures or errors, that has either a direct or consequential effect on the airplane, its occupants and/or other persons considering:

- flight phase; and
- relevant adverse operational or environmental conditions; and
- external events.

Hazardous Failure Condition: one that would reduce the capability of the airplane or the ability of the flightcrew to cope with adverse operating conditions to the extent that there would be:

- a large reduction in safety margins or functional capabilities;
- physical distress or excessive workload such that the flightcrew cannot be relied upon to perform their tasks accurately or completely; or
- serious or fatal injuries to a relatively small number of persons other than the flightcrew.

Major Failure Condition: a failure condition that would reduce the capability of the airplane or the ability of the flightcrew to cope with adverse operating conditions to the extent that there would be, for example:

- a significant reduction in safety margins or functional capabilities;
- a significant increase in flightcrew workload or in conditions impairing the efficiency of the flightcrew;
- discomfort to the flightcrew; or
- physical distress to passengers or cabin crew, possibly including injuries.

Minor Failure Condition: a failure condition that would not significantly reduce airplane safety, and involve flightcrew actions that are well within their capabilities. Minor failure conditions may include, for example:

- a slight reduction in safety margins or functional capabilities;
- a slight increase in flightcrew workload, such as routine flight plan changes; or
- some physical discomfort to passengers or cabin crew.

Remote Failure Condition: a failure condition that is not anticipated to occur to each airplane during its total life, but which may occur several times when considering the total operational life of a number of airplanes of the type.

Single Failure: any occurrence, or set of occurrences that cannot be shown to be independent from each other, that affect the operation of components, parts, or elements such that they can no longer function as intended (see definition of "Failure," above).

Proposed Changes to § 25.1301(d)

Paragraph (d) of the current § 25.1301 ("Function and installation") states that each item of installed equipment must "function properly when installed." The FAA proposes to delete that paragraph, because it would be redundant to the proposed revision to § 25.1309(a), described later in this NPRM.

Proposed Changes to § 25.1309 -- General

Broadened Applicability: This proposed revision to § 25.1309 would eliminate the reference to equipment, systems, and installations whose proper functioning is required by "this subchapter" (that is, 14 CFR subchapter C, "Airplane"). Currently, § 25.1309 requires that only the equipment, systems, and installations whose functioning is required by subchapter C must be designed to ensure that they perform their intended functions under any foreseeable operating condition.

The idea of limiting the required equipment and systems in the current way arose during the development of amendment 25-41 (42 FR 36960, July 18, 1977), which established the current version of § 25.1309. The FAA had considered using the word "chapter" instead of "subchapter" in § 25.1309(a) and (e), so as to include all systems, equipment, and installations covered by 14 CFR. However, this was not adopted because comments to NPRM 75-23 (40 FR 23048, May 27, 1975), Docket No. 14625, objected to the rule applying to systems, equipment, and installations that are required by the subchapters dealing with various operating rules. In addition, a concern was raised that, if the rule were worded in that way, it could be interpreted as requiring the installation of equipment prescribed by an operating rule in order to obtain a type certificate, even though the airplane was not going to be operated in accordance with those operating rules.

This proposed change to § 25.1309 would eliminate the reference to the "subchapter" altogether and, in effect, would broaden the applicability of the entire rule to "any equipment or system as installed in the airplane," regardless of whether it is required for type certification, operating approval, or not required at all (that is, if it is strictly optional equipment). While this proposed change is not intended to require the installation of equipment prescribed only by an operating rule in order to obtain a type certificate, it is intended to apply the requirements of § 25.1309 to such equipment when

installed. For equipment required by the operating rules or for optional equipment, relevant operating rules and associated supporting advisory material at the time of type certification may be applied in addition to, or in lieu of, this section at the discretion of the Administrator.

With the increasing complexity and interdependence of airplane equipment and systems, as well as the desire to improve safety, evaluation of all installed equipment, systems, and associated components at the time of type certification and identification of the standards that were used to evaluate them is both appropriate and necessary.

Clarification of Applicability: The FAA's historical policy in applying the requirements of § 25.1309 has been to consider that the rule is one of general applicability. This means that the requirements of the § 25.1309 are applicable unless those requirements conflict with more specific requirements contained in another section of part 25. On the other hand, the JAA's parallel JAR 25.1309 rule states that it is applicable in addition to the requirements of other sections of JAR 25. In practice, both § 25.1309 and JAR 25.1309 have not been applied if:

- compliance was technologically, economically, or logistically impracticable, and
- the hazard was adequately regulated by other sections of part 25.

Further, where compliance with other part 25 regulations inherently provides compliance with the intent of one or more of the requirements of § 25.1309, the FAA has not required applicants to perform a demonstration of compliance dedicated solely to § 25.1309. Consequently, this sometimes has lead to inconsistency in the interpretation of applying § 25.1309.

Other factors that led to incorrect application of this regulation include:

- The reference to "installations" in (a), but not (b), has led to confusion that "installation" may only be a consideration for § 25.1309(a),

- Confusion as to whether § 25.1309(b) and (c) apply to installed equipment and systems not required for type certification (see the discussion above on "broader applicability").

Additionally, questions persist as to whether or not compliance must consider operating, environmental, or situational conditions where the airplane is "out of service" (for example, in storage, undergoing maintenance activities away from the flight line, or on ferry flights). Most of these questions are associated with the performance and safety of installed maintenance support equipment, or consideration of any special circumstances and equipment associated with ferry flights. The intent and practice is that § 25.1309 is always applicable to flight conditions, but only applicable to ground conditions while the airplane is "in service" (that is, from the time the airplane arrives at a gate or other location for pre-flight preparations, until it is removed from service for shop maintenance, storage, etc.). While this does include conditions associated with line maintenance, dispatch determinations, embarkation and disembarkation, taxi, or the like, it does not include periods of shop maintenance, storage, or other "out of service" activities.

Finally, there has long been a question as to whether risks to persons other than airplane occupants and crew should be taken into account when assessing compliance with § 25.1309. Such risks include, for example, threats to people overflown or adjacent to the airplane during ground operations, electric shock threats to mechanics, and other similar situations. Because such risks are usually insignificant when compared with the risk to the airplane and its occupants, applicants have not typically addressed these risks in demonstrating accepted means of compliance with § 25.1309. Consequently, this has been mistakenly interpreted to mean that such risks need not be considered at all. The FAA has found designs non-compliant simply due to an unacceptable potential threat to persons outside the airplane or to line mechanics.

This proposed rulemaking action would more specifically establish the applicability of requirements of § 25.1309. To do this, the FAA has included new introductory text to this section to specify that the requirements of § 25.1309 are applicable in addition to specific regulations that may apply, except where the requirements of § 25.1309, or a part of them, are expressly excepted. This introductory text also would identify the particular conditions covered by other sections of part 25 that are excepted from one or more of the requirements of § 25.1309. Those conditions are:

- flight control jams covered by § 25.671(c)(3) ("Control Systems, General");
- brake failures covered by § 25.735(b)(1) ("Brakes"); ***[Editorial Note: Before publishing, make sure § 25.735(b)(1) has been adopted as final rule]***
- emergency egress conditions covered by § 25.810(a)(1)(v)("Emergency egress assist means and escape routes") and § 25.812("Emergency lighting"); and
- powerplant failure conditions excepted under the § 25.901(c) ("Powerplant Installation) proposal discussed elsewhere in this notice.

This proposed change to clarify and explicitly define the applicability of § 25.1309 would have little effect on current procedures and methods for properly applying the requirement to design features of equipment, systems, and installations.

Proposed Changes to § 25.1309(a)

Description of the Specific Change: The FAA proposes to revise § 25.1309(a) to specify that, with certain exceptions, the airplane equipment and systems must be designed and installed so that they "perform as intended" under the airplane's operating and environmental conditions. The proposed change broadens the scope of existing paragraph 25.1309(a) to all installed airplane equipment and systems whose improper functioning would reduce safety regardless of whether required by type certification

rules, operating rules, or not required. The phrase "improper functioning" is intended to identify equipment and system failures which have an effect on airplane safety and are therefore failure conditions. Any installed equipment or system, the failure or malfunction of which results in a minor or more severe failure condition is considered to have an effect on the safe operation of the airplane. Paragraph 25.1309(a) would have requirements for two different classes of equipment and systems installed in the airplane. Paragraph 25.1309(a)(1) covers the equipment and systems that have a safety effect, or are installed in order to meet regulatory requirement. This class of equipment and systems are required to "perform as intended under the airplane operating and environmental conditions." Paragraph 25.1309(a)(2) requires all other equipment and systems to not have an effect on the safe operation of the airplane. Consequently these equipment and systems are not required to "perform as intended."

Clarification of "Perform as Intended": The current text of § 25.1301(d) (see discussion above) that requires installed equipment to "function properly when installed" was derived from several previous FAA regulations. The earliest regulation (circa 1943) was Civil Air Regulation (CAR) 04.500, which required that the items "shall function to the satisfaction of the Administrator." That CAR was recodified in 1949 as CAR 4b.682(d), which required the items to be "demonstrated to function satisfactorily in the airplane." That section was later (circa 1950) recodified as CAR 4b.601(d), which required that the items must be "demonstrated to function properly in the airplane."

The current text of § 25.1309(a) requires these items to "perform their intended functions under any foreseeable operating condition." This requirement came directly from the earlier CAR 4b.606(a), adopted in 1952, which required the items to "perform their intended functions reliably under all reasonably foreseeable operating conditions."

The terms "reliably" and "reasonably" used in CAR 4b.606(a) were simply dropped during recodification to § 25.1309(a), with no change in intent.

In each case, the "Administrator" has been left to exercise significant discretion as to what the terms "properly," "satisfactorily," or "reliably" were intended to mean for a given piece of equipment under given conditions, as well as what must be considered a "foreseeable operating condition." As a result, these have evolved to mean different things for different critical equipment and systems. For example, the "environment" to which a piece of equipment must be "qualified," as well as the "pass/fail criteria" for that equipment's qualification, are often a function of the "criticality" assigned to the equipment. The intent of the words "properly" and "intended" within the current § 25.1301(d) and § 25.1309(a), respectively, have been interpreted by the FAA to mean "fulfill the purposes for which the subject system/component exists in the manner expected by system specifications".

The FAA generally finds compliance with § 25.1301(d) and § 25.1309(a) if equipment and systems exhibit failures that only occur after prolonged or repetitive exposure to operating and/or environmental conditions. Conversely, if these same failures are found to occur due to a single exposure to operating and/or environmental conditions, the FAA generally views them as not complying with § 25.1301(d) and § 25.1309(a). Nevertheless, the FAA sometimes finds type designs subject to such failures acceptable if these failures are judged to not significantly contribute to the risks already accepted under § 25.1309(b). For example, some degradation in functionality and capability are routinely allowed during some environmental qualifications, such as HIRF and lightning testing. In fact, paragraph (b) of § 25.1316 (System lightning protection") specifically allows the functionality and capabilities of some electrical/electronic systems to be lost when the airplane is exposed to lightning, provided that "these functions can be recovered in a timely manner."

The general practice is that the "perform-as-intended" regulations [such as §25.902(b)(2), §25.1301(d), §25.1309(a)] are used to provide assurance that the equipment and systems will function as intended when operating in the expected operating conditions. It is recognized, however, that random failures will occur throughout the aircraft life and that the failed device may no longer "perform-as-intended". The acceptability of failures and their associated risks are covered by the "fail-safe regulations" [such as the generally applicable § 25.901(c) and § 25.1309(b), among others, or the more specific §§ 25.671(c)(3), 25.735(b)(1), 25.810(a)(1)(v), 25.812, and 25.903(d)(1), 25.1316, among others]. [***Editorial Note: Before publishing, make sure § 25.735(b)(1) has been adopted as final rule and § 25.671 references still appropriate.***] For example, lightning striking an external antenna is a "foreseeable" event and can be safely accommodated, but not by the struck equipment itself. If such a lightning strike would result in a "minor" or "major" failure condition (see Definitions, above), it might be considered acceptable if the antenna is located in an area of the airplane where the probability of lightning attachment is low. However, if it would result in a catastrophe, then additional design protections would be necessary, such as providing redundancy or some other design to mitigate such catastrophes.

Clarification of "Under the Airplane Operating and Environmental Conditions":

With this proposed revision to § 25.1309(a), the conditional qualifiers of "when installed" and "under any foreseeable operating condition," contained in the current §§ 25.1301(d) and 25.1309(a), would be replaced by:

". . . under the airplane operating and environmental conditions . . ."

The proposed phrase is intended to mean:

- throughout the full normal operating envelope of the airplane, as defined by the Airplane Flight Manual, together with any modification to that

envelope associated with abnormal or emergency procedures and any anticipated crew action; and

- under the anticipated external and internal airplane environmental conditions, as well as any additional conditions where equipment and systems are assumed to "perform as intended".

This change was made in response to the observation that although certain operating conditions are foreseeable, achieving normal performance when they exist is not always possible. For example, ash clouds from volcanic eruptions are foreseeable, but airplanes with current technology cannot safely fly in such clouds.

Provisions for Equipment and Systems with No Safety Effect on the Operation of the Airplane: Modern transport airplanes contain equipment that is not intended to have an effect on the safe operation of the airplane. Typically, this equipment is associated with amenities for the passengers and includes such items as:

- entertainment displays,
- audio systems,
- in-flight telephones,
- non-emergency lighting, and
- equipment for food storage and preparation.

A problem for airplane manufacturers arises when certification authorities have questioned installations of this type when the equipment does not perform in accordance with its system specifications and, therefore, is "not functioning properly when installed." This poses a non-compliance issue because the regulations require that all equipment, systems, and installations function properly when installed.

However, the proper functioning of "amenities," such as those items listed above, is not necessary for the safe operation of the airplane. The only safety issues associated

with this type of equipment and systems are the possibility that, as a result of its normal operation or in the event of its failure, it could directly injure someone or adversely affect the functioning of the crew or other equipment and systems. Accordingly, the provision for exceptions in the proposed § 25.1309(a)(2) allows these types of "amenities" to be approved even if they frequently do not perform as intended.

Under proposed § 25.1309(a)(2), any frequent failure of amenities to "perform as intended" must not adversely affect the safety of the airplane or its occupants, or the proper functioning of the equipment and systems that do have a safety impact. That is, they must not directly injure persons or adversely affect the crew or other equipment and systems. The intent of this accommodation is to reduce the cost of certification to airplane and equipment manufacturers without reducing the level of safety provided by part 25. No safety benefit is derived from demonstrating that equipment performs as intended, if failing to perform as intended would not result in a "minor" or more severe failure condition. Instead, as a minimum, the FAA would require that a qualitative evaluation of the design and installation of such equipment and systems as installed in the airplane be performed to determine that neither their normal operation nor their failure will adversely affect crew workload, the operation of other systems, or the safety of persons.

The FAA expects that, in most cases, normal installation practices will result in sufficiently obvious isolation of the impacts of such equipment on safety that substantiation can be based on a relatively simple qualitative installation evaluation. If the possible impacts, including failure modes or effects, are questionable or isolation between systems is provided by complex means, more formal structured evaluation methods or a design change may be necessary.

Environmental Qualification of "Amenities": In accordance with the proposed revision to § 25.1309, the environmental qualification requirements for certification of

the airplane equipment and systems that are not associated with any functional hazard would be reduced to those tests necessary only to verify that their presence, operation, or failure does not:

- interfere with the proper operation of other equipment,
- directly injure anyone, or
- increase the flightcrew's workload unreasonably.

Although these types of equipment and systems are not required to function properly when installed, they would be required to be functioning when they are tested to verify that they do not interfere with the operation of other airplane equipment and systems and do not pose a hazard in and of themselves. Other environmental testing for this type of equipment is no longer required.

Overall Effect of Revision to § 25.1309(a): In its effect, the proposed revision to § 25.1309(a) would:

- harmonize this regulation with the parallel JAR requirement;
- clarify when installed equipment and systems must perform as intended; and
- remove unnecessary requirements currently imposed on installed equipment and systems that are not associated with any functional hazard.

Further guidance concerning § 25.1309(a) has been made part of the new proposed Advisory Circular (AC) 25.1309-1B, "System Design and Analysis," announced elsewhere in this Federal Register.

Proposed Changes to § 25.1309(b)

Description of the Specific Change: The FAA proposes to revise § 25.1309(b) to require that the airplane systems and associated components considered separately and in relation to other systems must be designed and installed so that:

- each catastrophic failure condition is extremely improbable and does not result from a single failure; and
- each hazardous failure condition is extremely remote; and
- each major failure condition is remote.

The following discussion provides supplemental background and current FAA interpretations regarding the intent of both the existing and proposed §25.1309(b).

History and Role of Probability and Statistics: Since the earliest days of prescribing and assessing airworthiness, judging "probability" has been necessary. The required capacities, capabilities, margins, environmental qualifications, levels of fault tolerance, etc., all reflect what conditions and events are "anticipated" to occur and "deemed practicable" to safely accommodate. For instance, duplicated flight control cables were required in biplanes because it was thought that the probability of failure of one cable was too high, and providing duplication was practicable. As these "fail-safe" requirements evolved, making such airworthiness determinations relied (and continues to rely) heavily on "engineering judgement" and qualitative methods. However, as the number, criticality, complexity, integration, and number of parts of aircraft systems increased, the combinations of conditions and events that a design must safely accommodate became more difficult to effectively judge by qualitative means alone. To arbitrarily specify duplication or triplication of components as a means to address possible failures was no longer sufficient. The probability of total system failure can be indefinitely decreased by increasing the numbers of independent "channels" in a system.

However, each layer of redundancy has costs, complexities, and the inherent risk of unforeseen failure conditions associated with it.

The aviation industry recognized as early as the late 1950's that rational acceptable quantitative probability values would have to be established. During the 1960's, quantitative probability gained in popularity and acceptance as a tool for objectifying engineering judgements (e.g., authority criteria for autoland systems).

The British Civil Airworthiness Requirements (BCAR) were the first to establish acceptable quantitative probability values for transport airplane systems. The primary objective in establishing these guidelines was to ensure that the proliferation of critical systems would not increase the probability of a serious accident. Historical evidence at the time indicated that the probability of a serious accident due to operational and airframe-related causes was approximately one (accident) per one million hours of flight. Further, about 10 percent of the total accidents were attributed to failure conditions caused by the airplane's systems. Consequently, it was determined that the probability of a serious accident from all such failure conditions should not be greater than one per 10 million flight hours, or "1 x 10^{-7} per flight hour," for a newly designed airplane. Commensurately greater acceptable probabilities were established for less severe outcomes.

The difficulty with the 1 x 10^{-7} per flight hour probability of a serious accident, as stipulated by the BCAR guideline, was that all the systems on the airplane must be collectively analyzed numerically before it was possible to determine whether the target had been met. For this reason, the (somewhat arbitrary) assumption that there would be no more than 100 failure conditions contributing to a catastrophe within any given transport category airplane type design was made. It apparently was also assumed that, by by regulating the frequency of less severe outcomes:

- only "catastrophic failure conditions" would significantly contribute to the probability of catastrophe, and
- all contributing failure conditions could be foreseen.

Therefore, the targeted allowable average probability per flight hour of 1×10^{-7} was apportioned equally among 100 catastrophic failure conditions, resulting in an allocation of not greater than 1×10^{-9} to each. The upper limit for the average probability per flight hour for catastrophic failure conditions became the familiar "1×10^{-9}." Failure conditions having less severe effects could be relatively more likely to occur.

The FAA adopted these BCAR guidelines in Advisory Circular (AC) 25.1309-1, "System Design Analysis" (dated September 7, 1982). That AC established an approximate probability value for the term "extremely improbable" as used in §25.1309(b), as well as the other relevant probability terms.

Since their adoption by the FAA, these probability guidelines and their role in demonstrating and finding compliance with §25.1309(b) have been a source of misinterpretation, confusion, and controversy. The FAA intends the numerical values in AC 25.1309 associated with the probabilistic terms in §25.1309(b) to be used as acceptable risk guidelines in those cases where the effect of system failures are examined by quantitative probability methods of analysis. The use of numerical probability analysis and these guidelines is simply intended to supplement, but not replace, qualitative methods based on engineering and operational judgements. Whether a design meets these guidelines simply provides some evidence to support an informed finding by the FAA as to whether or not the design complies with the intent of the rule.

The Intent of the Term "Extremely Improbable": The objective of using this term in the regulations has been to describe a condition (usually a failure condition) that has a

probability of occurrence so remote that it is not anticipated to occur in service on any transport category airplane to which the standard applies. However, while a rule sets a minimum standard for all the airplanes to which it applies, compliance determinations are limited to individual type designs. Consequently, in practice, all that has been required of applicants is a sufficiently conservative demonstration that a condition is not anticipated to occur in service during the entire operational life of all airplanes of the type design being assessed. Experience indicates that the level of conservatism traditionally provided in proper safety assessments more than compensates for the cumulative risk effects across airplane types.

The means of demonstrating that the occurrence of an event is "extremely improbable" varies widely, depending on the type of system, component, or situation that must be assessed. Failure conditions arising from a single failure are not considered "extremely improbable;" thus, probability assessments normally involve failure conditions arising from multiple failures. Both qualitative and quantitative assessments are used in practice, and both are often necessary to some degree to support a conclusion that an event is "extremely improbable." Generally, performing only a quantitative analysis to demonstrate that a failure condition is extremely improbable is insufficient due to the variability and uncertainty in the analytical process. Any analysis used as evidence that a failure condition is extremely improbable should include justification of any assumptions made, data sources and analytical techniques to account for the variability and uncertainty in the analytical process. Refer to AC25.1309-1B, or later revision, for acceptable means of compliance.

In short, wherever part 25 requires that a condition be "extremely improbable," the compliance method -- whether qualitative, quantitative, or a combination of the two --

along with engineering judgment, must provide convincing evidence that the condition should not occur in service.

Inclusion of Specific Failure Condition Categories and Probabilities: The proposed § 25.1309(b) would include specific terms to describe failure condition categories and probabilities that are in current usage within the aviation industry. It is recognized that some of these terms may be used elsewhere within 14 CFR with different meanings. The FAA may consider issuing a miscellaneous regulatory amendment in the future to standardize the use of these terms to classify failure conditions. However, for the purposes of this proposed regulation, these terms are defined under the section entitled "Definitions" that appears earlier in this preamble.

Although the terminology in § 25.1309(b) would be changed from the current regulation, the intent would not be changed. The new text of the rule would serve to "document" and formally institute the current interpretation and application of these terms.

Prohibiting Catastrophic Single Failures: The proposed text of § 25.1309(b) would explicitly include a fail-safe design requirement that single failures must not result in catastrophic failure conditions, regardless of their probability. This has been the FAA's practice and, in fact, was the only requirement of this sort under the FAA's early Civil Air Regulations (CAR) and the earliest version of § 25.1309.

Harmonization and Standardization: The proposed text of § 25. 1309(b) would be harmonized with that of the parallel JAR. Further guidance concerning § 25.1309(b) has been made part of the new proposed Advisory Circular (AC) 25.1309-1B.

Proposed Changes to § 25.1309(c)

Description of the Specific Changes: The FAA proposes to revise the text of § 25.1309(c) to continue to require that:

- information concerning unsafe system operating conditions be provided to the crew to enable them to take appropriate corrective action, and
- systems and controls, including indications and annunciation, be designed to minimize crew errors that could create additional hazards.

The proposed revised paragraph would also require that a warning indication be provided if immediate corrective action is required.

Categorization of Required Flightcrew Information: Proposed § 25.1309(c) would be compatible with the requirements of the current § 25.1322 ("Warning, caution, and advisory lights"), which distinguishes between caution, warning, and advisory lights installed on the flight deck. Rather than only providing a warning to the flightcrew, which is required by the current rule, the proposed § 25.1309(c) would require that information concerning unsafe system operating conditions be provided to the flightcrew.

A warning indication would still be required if immediate action by a flightcrew member were required. However, the particular method of indication would depend on the urgency and need for flightcrew awareness or action that is necessary for the particular failure. Inherent airplane characteristics may be used in lieu of dedicated indications and annunciations if they can be shown to be timely and effective. However, the use of periodic maintenance or flightcrew checks to detect significant latent failures when they occur is undesirable and should not be used in lieu of practical and reliable failure monitoring and indications.

Minimization of Crew Errors: The proposed wording of § 25.1309(c) is intended to clarify the current rule by specifying that the design of systems and controls, including indications and annunciations, must minimize crew errors that could create additional hazards. The additional hazards to be minimized are those that could occur after a failure

and are caused by inappropriate actions made by a crew member in response to the failure. Unless they are accepted as part of normal aviation abilities, any procedures for the flightcrew to follow after the occurrence of a failure indication or annunciation should be described in the approved Airplane Flight Manual (AFM), AFM revision, or AFM supplement.

Interpretation of Unsafe System Operating Conditions: The following interpretive material provides guidance to aid in making determinations as to whether a given system operating condition is "unsafe". It is not intended to be the only way to define an unsafe condition.

> Any system operating condition which, if not detected and properly accommodated by crew action, would significantly contribute to or cause one or more serious injuries is an "unsafe system operating condition" for the purposes of this regulation. Even if airplane operation or performance is unaffected or insignificantly affected at the time of a failure, information to the flightcrew is required if it is considered necessary for the flightcrew to take any action or observe any precautions.

If operation or performance is unaffected or insignificantly affected, information and alerting indications may be inhibited during specific phases of flight where informing the flightcrew is considered more hazardous than not informing them.

Further guidance concerning § 25.1309(c) has been made part of the new proposed AC 25.1309-1B.

Proposed Changes to § 25.1309(d)

The current § 25.1309(d) describes a specific means of compliance with the current requirements contained in § 25.1309(b), relative to the design of airplane systems and associated components. It requires that compliance with § 25.1309(b) must be

shown either by analysis, ground, flight, or simulator testing, where necessary. It also describes the features that such analysis must consider, such as

- possible modes of failure;
- probability of multiple or undetected failures;
- resulting effects on the airplane and occupants; and
- the crew warning cues and corrective action required.

The FAA has reconsidered the need for this specific section and has concluded that it should be deleted altogether, since it describes a specific, yet incomplete, means of compliance with the regulation. The FAA considers that, rather than trying to revise this section to cover all means and considerations, the described information is better suited to be contained within advisory material. As mentioned earlier, the FAA has developed proposed AC 25.1309-1B, which describes a means of compliance that is similar, but not identical, to the requirements currently stated in § 25.1309(d). A notice announcing the availability of that proposed AC is contained elsewhere in this Federal Register.

Proposed Changes to § 25.1309(e) and (f)

The FAA proposes to remove the current paragraphs (e) and (f) from § 25.1309 and include them as a new § 25.1310, as described in more detail below.

Proposed Changes to § 25.1309(g)

The FAA proposes to delete the requirements that are currently contained in § 25.1309(g), which concern a means of compliance to §25.1309(a) and (b) for electrical system and equipment design. The FAA finds that those requirements are redundant to the general application of § 25.1309 and other sections specifically related to electrical systems. The considerations for environmental conditions are now specified in §25.1309(a).

Proposed New § 25.1310

The FAA proposes to add a new § 25.1310, entitled "Power source capacity and distribution." The content of this proposed requirement would be the same as that contained in § 25.1309(e) and (f). These requirements are not directly related to the other safety and analysis requirements of § 25.1309, and the FAA considers it appropriate to state them separately for the purpose of clarity. There would be no change to these requirements, other than their new section number.

The addition of proposed § 25.1310 would entail no significant change to the current requirements, and there would be no increase in costs associated with it.

Proposed Changes to § 25.901(c)

The FAA also proposes to revise § 25.901(c) ("Subpart E -- Powerplant, General, Installation") to:

- clearly identify the applicability of § 25.1309 to the powerplant installation;
- provide consistent system design and analysis standards for both subparts E and F of part 25; and
- harmonize § 25.901(c) with the parallel section of the JAR.

The proposed text of § 25.901(c) would specify that the powerplant installation must comply with § 25.1309, except that the effects of the following items on the airplane and its occupants need not comply with § 25.1309(b):

- an engine case burnthrough or rupture,
- an uncontained engine rotor failure, and
- propeller debris release.

The FAA considers that it currently is not practicable to require applicants to consider these failure conditions when demonstrating compliance with the requirements of § 25.1309(b). Instead, these effects and rates of failures are already considered and minimized by required compliance with:

- 14 CFR part 33 ("Airworthiness Standards: Aircraft Engines"),
- 14 CFR part 35 (" Airworthiness Standards: Propellers")
- § 25.903(d)(1) ("Engines"),
- § 25.905(d) ("Propellers"), and
- § 25.1193 ("Cowling and nacelle skin")

This proposed revision to § 25.901(c) is intended to provide an overall safety assessment of the powerplant installation that is consistent with the requirements of § 25.1309, while accommodating unique powerplant installation compliance policies. It is intended to augment rather than replace other applicable part 25 design and performance standards for transport category airplanes.

Additionally, the FAA has developed a new proposed AC 25.901-1, "Safety Assessment of Powerplant Installations," to provide guidance that is unique to powerplant installations when complying with § 25.1309. The availability of this proposed AC is announced elsewhere in this Federal Register.

Effects of This Proposal on Other Sections of the Regulations

§ 25.671 ("Control Systems, General"): The proposed § 25.1309(b) would require that airplane systems and associated components be designed so that any catastrophic failure condition is extremely improbable and does not result from a single failure. Most anticipated failures of the flight control system are intended to meet this requirement. However, failures that result in a jam of a flight control surface or a pilot control, as addressed by § 25.671(c)(3), are excepted from the requirements of § 25.1309(b)(1) and (b)(2). Historically, the capabilities of the control system that are required by § 25.671(c)(3) have been used to regulate the risk of such events.

Specifically, § 25.671(c)(3) requires that an airplane must be shown by analysis, tests, or both, to be capable of continued safe flight and landing after:

> *"(c) Any jam in a control position normally encountered during takeoff, climb, cruise, normal turns, descent, and landing unless the jam is shown to be extremely improbable, or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable."*

The relatively low exposure to and severe effects of control jams at extreme deflections has led the FAA to conclude that accommodating control jams at deflections beyond those covered by § 25.671(c)(3) is not in the public interest. Further, the FAA finds that the current requirements of § 25.671(c)(3) have been shown to provide a satisfactory level of safety without the need to analyze each particular circumstance under which jams could occur. Consequently, flight control jams covered by § 25.671(c)(3) historically have been, and will continue to be, excepted from meeting the requirements of § 25.1309(b)(1) and (b)(2). The FAA proposes to specify these exceptions in the introductory text to § 25.1309.

The revision and harmonization of § 25.671 is a topic currently under review by the Flight Controls Harmonization Working Group within ARAC. This ARAC activity may subsequently produce additional relevant recommendations.

§ 25.735 ("Brakes"): ***[Editorial Note**: § 25.735(b)(1) does not currently exist, but has been proposed. Before publishing 25.1309, make sure 25.735 has been adopted as final rule.]*The proposed revised requirements of § 25.1309(b) would not apply to single failures covered by § 25.735(b)(1)**,** relevant to the requirement that limits the effect of a single failure of the brake system to doubling the brake roll stopping distance. The diverse circumstances under which such a failure could occur would tend to make any structured determination of the outcome or frequency problematic and indeterminate. Additionally, the FAA finds that the current requirements of § 25.735 have been shown

to provide a satisfactory level of safety without the need to analyze each particular circumstance under which the single failure could occur. The FAA proposes to specify these exceptions in the introductory text to § 25.1309.

§ 25.810 ("Emergency egress assist means and escape routes") and § 25.812 ("Emergency lighting"): The proposed revised requirements of § 25.1309(b) would not apply to the failure effects described in §§ 25.810(a)(1)(v) and 25.812. The failure conditions relevant to the cabin safety equipment installations addressed by those regulations are associated with varied evacuation scenarios for which the probability can not be determined. It has not been proven possible to define appropriate scenarios under which compliance with § 25.1309(b) can be demonstrated. The FAA considers it more practical to require particular design features or specific reliability demonstrations for these items of equipment, and to except them from the requirements of § 25.1309(b). Traditionally, the FAA has found this approach acceptable. This exception would be specified in the introductory text of proposed § 25.1309.

RESPONSE TO PETITIONS FOR RULEMAKING

During the development of this proposed rule, the FAA considered two relevant petitions for rulemaking that were previously submitted:

Docket No. 25045:

The first petition was submitted by Mr. Everett Morris in a letter dated July 16, 1986, and was published in the Federal Register on September 18, 1986 (51 FR 33061) as Docket No. 25045. The petitioner makes four specific requests of the FAA to change 14 CFR as follows:

REQUEST 1. Add to 14 CFR part 1 the definitions of probability as they are used with respect to the probability of the occurrence of a failure condition. The petitioner suggests the following specific definitions:

- Extremely Improbable: a failure that is not expected to occur on any aircraft of the type throughout the life of the fleet.
- Improbable: a failure that may be expected to occur once in the life of an aircraft and to occur several times in the life of the fleet.
- Probable: a failure that may be expected to occur several times during the life of an aircraft.

REQUEST 2. Make § 25.1309 consistent with the failure considerations of § 25.671 ("Control Systems, General"). The specific change that the petitioner requests is to revise the text of § 25.1309(b) to include an additional requirement that the airplane systems and associated components must be designed so that:

- any failure condition whose occurrence is shown to be probable must also be shown to have only minor effects on the airplane; and
- the criteria of the fail-safe design concept have been met.

REQUEST 3. The petitioner also requests revising § 25.1309(c), which concerns providing warning information to the flightcrew, so that the information provided will enable them to take appropriate action "for safe continuation and landing of the flight, including any such information or servicing as may be necessary to ensure airworthiness of the airplane on the following flight segment."

REQUEST 4. Incorporate into part 25, as an appendix, the "Fail-Safe Design Concept" that was previously published and approved as Appendix 2 of AC 120-42A, "Extended Range Operation with Two-Engine Airplanes." The petitioner requests that this new appendix to part 25 contain language similar to that found currently in AC 120-42A. The text of the new appendix should explain the fail-safe design methodology, and the principle of considering the effect of failures and combination of failures when defining a safe design. The commenter also suggests that the text include guidance on such things as:

- redundancy,
- isolation of systems,
- system independence,
- failure indication,
- functional verification,
- damage tolerance,
- design of failure paths, and
- flightcrew procedures.

Finally, the petitioner states that the amendments he proposes will minimize the variations in interpretation associated with the implementation of § 25.1309, and eliminate the possibility of applying an unrealistic assessment of any single failure as extremely improbable. The petitioner asserts that such an assessment has been used to justify the omission of redundant of back-up devices needed in the event of failures that are "not expected to occur."

The period for public comment on this petition ended November 17, 1986, and two comments were submitted. Both commenters generally support the petition. Both commenters suggest that the definitions of probability and the fail-safe design concept be placed in a new advisory circular pertinent to § 25.1309, rather than in the regulations. One commenter also requests that, if the regulations are to be amended, the FAA should first publish an Advance NPRM in order to provide maximum opportunity for the public to contribute to the development of these safety standards.

The FAA has considered the petitioner's requests, as well as those of the commenters, and has made the following determinations:

As to the petitioner's **REQUEST 1**, the FAA concurs that a better definition of the probability terms is warranted, especially as they apply to the design of systems, equipment, and installations. As discussed previously in detail, the FAA is proposing in

this NPRM to revise § 25.1309(b) to include failure condition categories and probability terms relating to system design considerations. The FAA has provided qualitative definitions of these terms in this preamble to the notice, as well as in the proposed new AC 25.1309-1B, announced elsewhere in this Federal Register.

As to the petitioner's **REQUEST 2**, the FAA does not concur that such revisions to § 25.1309(b) are appropriate. The FAA's proposed change to § 25.1309 would clarify the relationship between the requirements of § 25.671(c) and § 25.1309(b). Further, the FAA considers that the current regulation already accommodates the petitioner's request that "any failure condition whose occurrence is shown to be probable must also be shown to have only minor effects on the airplane," although in the inverse: that is, for any effect that is not minor, the regulations specify a probability for it. The petitioner's request that § 25.1309(b) specifically require a finding that: "the criteria of the fail-safe design concept have been met," is not definitive enough to constitute a minimum safety standard. While all acceptable means of compliance must rely on one or more elements of the fail-safe design concept, as presented in the current guidance this "concept" does not represent a "criteria." Thus, it is more appropriate that this concept be provided as guidance rather than as a rule.

As to the petitioner's **REQUEST 3**, the FAA considers that both the current and the proposed revision to § 25.1309(c) adequately address the issue of providing information to the flightcrew to enable them to determine the appropriate corrective action to take when an unsafe system operating condition occurs. The FAA has long considered and applied the concept of "appropriate corrective action" in this case to include other than merely "immediate" corrective action -- that is, the crew is expected to identify not only what needs to be done at once to correct a problem, but what may need to be done to correct a problem after the airplane lands or before the next flight, for example. While § 25.1309(c) does not specify what that corrective action should be, it is

implicit that the flightcrew will be an integral participant in identifying and addressing airworthiness concerns. Additionally, assumptions about subsequent maintenance or dispatch limitations should be reflected within the Instructions for Continued Airworthiness (for example, refer to AC 25-19, "Certification Maintenance Requirements").

As to the petitioner's **REQUEST 4**, the FAA does not consider it appropriate to revise part 25 by adding a new appendix that would describe the "fail-safe design concept" currently contained in the AC related to ETOPS. Many of the subjects covered in the AC (among them: redundancy, damage tolerance, and the like) are already addressed in the regulations. The material in that AC is chiefly design-specific, and all of the items covered may not be appropriate for all designs -- some items may be conducive to some designs, others may not need to be considered at all. It is impossible to tell which subset of the items would be achievable for every specific design. The FAA considers that this material better serves affected parties as advisory material, rather than regulation. In this way, applicants are provided with the flexibility that is essential for future design considerations.

Docket No. 25096:

The second petition for rulemaking was submitted by the Aerospace Industries of America (AIA) by a letter dated October 2, 1986, and was published in the Federal Register on January 16, 1987 (52 FR 1924) as Docket No. 25096. (**NOTE**: Representatives from the AIA participated on the ARAC team that recommended the proposed rulemaking contained in this NPRM.) The petitioner requests that the FAA change the wording and organization of §§ 25.903, 25.1301, and 25.1309 to provide a basis for resolution of recurrent problems in the application and interpretation of these sections.

Specifically, the petitioner requests the following changes:

REQUEST 1. Consider separately the three topics that currently are addressed in § 25.1309, namely:

- the ability of required equipment to function as intended in all foreseeable operating environments [paragraph 25.1309(a)];
- designing for and analyzing the effects of functional failure conditions [paragraphs 25.1309(b), (c), and (d)]; and
- essential loads and their power supplies [paragraphs 25.1309(e), (f), and (g).

The petitioner suggests that the text of § 25.1309(a) be moved into § 25.1301 and the text of § 25.1309(e), (f), and (g) be moved to a separate new section in part 25. This arrangement would then allow § 25.1309 to focus on only one subject: controlling the occurrence and effect of functional failure conditions.

REQUEST 2. Revise § 25.1309 to clarify that its requirements are not intended for general use in the certification of powerplant installations. Additionally, revise § 25.901 and § 25.903 to acknowledge both the realities of recent aircraft certification programs and the certification needs of future powerplant programs. The petitioner states that isolation in the classical "brick wall" sense is not always reasonable to achieve when the planned normal airplane operating configuration uses increased system integration to achieve airplane performance and operating efficiency goals. While isolation should remain the major design objective in powerplant installation, as well as the primary method for achieving powerplant system safety, the regulations must also recognize the appropriateness of demonstrating the safety equivalence to isolation under certain circumstances. Specifically, the petitioner requests that § 25.1309(a) be revised to state:

> *"(a) This section is applicable to all airplane systems and equipment as installed, except where specifically stated safety requirements are defined in other sections of this part. The*

requirements of this section may not be used to extend or supplement the safety requirements of subparts B., C. or E."

REQUEST 3. Add new text after § 25.1309(b)(3) that states:

"All relevant factors shall be considered when judging the consequence of failure conditions on continued safe flight and landing, and on the capability of the airplane or flightcrew."

The petitioner considers this text appropriate to emphasize, and introduce as a regulatory requirement, that the probability of occurrence of all relevant factors (such as field length limitations, obstructions in the takeoff path, flightcrew action, weight altitude, temperature extremes, etc.) must be accounted for and included when assessing the consequence of failure conditions. The petitioner further states it would be unrealistic to assume that flightcrew action to compensate for the effects of all failure conditions will always be absent, and that other factors will always be present or at their extremes. Probabilities of occurrence for these parameters can be estimated by a rational process acceptable to the FAA and included in the failure effects assessments.

REQUEST 4. Revise the text of § 25.1309(d) to include the following statement:

"(d) . . . The analysis shall be qualitative and may be supplemented by a quantitative failure probability analysis, if shown to be appropriate and necessary . . ."

The petitioner states that this addition recognizes that a qualitative analysis is normally required if showing compliance with § 25.1309, but that quantitative or numerical failure probability analysis is not always appropriate. Thus, the applicant is responsible for determining the suitability of a numerical probability analysis as a supplement to other compliance data, and is expected to provide the rationale for proposing or not proposing such analyses as compliance data to the FAA upon request.

Finally, the petitioner states that, with all of the requested changes, no relaxation of safety standards is sought, intended, or proposed by its petition. The objectives are to clarify the intent of the regulations, and to recognize experience and improved understanding in the administration of and compliance with the regulations.

The comment period for this petition closed on March 17, 1987. One comment was received and the commenter supported the petition.

The FAA has considered this petition for rulemaking and agrees with the general intent of most of the petitioner's suggested changes. As described in detail previously, the FAA is proposing several revisions to the regulations that would address those suggested by this petitioner, including:

- Moving the text of current § 25.1309(e) and (f) into a separate new section § 25.1310, that would deal only with power source capacity and distribution (petitioner's **REQUEST 1**).
- Specifying that certain failure effects specified in other sections and subparts of part 25 are excepted from the requirements of § 25.1309 (petitioner's **REQUEST 2**).

However, the FAA does not concur fully with the petitioner's **REQUEST 3,** to revise the regulations to require that all relevant factors be considered when judging the consequence of failure conditions on continued safe flight and on the capability of the airplane or flightcrew. While it is a worthy concept, it also is an area that the FAA currently has no appropriate way to evaluate, quantify, or impose in regulatory terms.

The proposed new AC 25.1309-1B would contain procedures for conducting a system safety assessment (SSA) that, in part, does account for flightcrew, environmental, and situational factors. It discusses allowable probabilities appropriate for use in the context of a quantitative safety analysis performed to demonstrate compliance with § 25.1309, and provides a structured method to calculate the probability of failure

conditions for certain "average flights." Appendix 4 of the proposed AC also discusses probabilities that may be used for environmental conditions and operations factors in the SSA; it takes into consideration:

- environmental factors,
- aircraft configurations,
- flight conditions,
- mission dependencies, and
- other events.

For many of these items, however, there currently is no accepted standard data; therefore, it will be left up to the applicant to provide a justified value (if a probability less than 1 is to be used in the analysis), or to devise another way of determining a suitable value. Additionally, if a value less than 1 is used for any conditional probability, care must be taken to assure that the risk under any unusual, yet anticipated, flight conditions does not become excessive. The public is requested to submit comments on the proposed AC, and new significant data on this issue might be provided by the commenters.

In response to the petitioner's **REQUEST 4**, the FAA has reconsidered the purpose and intent of the current § 25.1309(d). As discussed previously, the FAA finds that paragraph to be more prescriptive rather than performance-based, because it describes one specific method of complying with the current requirements of § 25.1309(b). In light of this, the FAA has determined that it is better suited as advisory material and, therefore, has moved (and expanded) the text to the proposed AC 25.1309-1B.

Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. We have determined that there are no new information collection requirements associated with this proposed rule.

International Compatibility

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA determined that there are no ICAO Standards and Recommended Practices that correspond to these proposed regulations.

Executive Order 12866 and DOT Regulatory Policies and Procedures

Executive Order 12866, Regulatory Planning and Review, directs the FAA to assess both the costs and benefits of a regulatory change. We are not allowed to propose or adopt a regulation unless we make a reasoned determination that the benefits of the intended regulation justify the costs. Our assessment of this proposal indicates that its economic impact is minimal. Since its costs and benefits do not make it a "significant regulatory action" as defined in the Order, we have not prepared a "regulatory evaluation," which is the written cost/benefit analysis ordinarily required for all rulemaking proposals under the DOT Regulatory Policies and Procedures. We do not need to do the latter analysis where the economic impact of a proposal is minimal.

[FORMAL EVALUATION TO BE SUPPLIED BY APO]

Economic Evaluation, Regulatory Flexibility Determination, Trade Impact Assessment, and Unfunded Mandates Assessment

Proposed changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency propose or adopt a

regulation only upon a determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (19 U.S.C. section 2531-2533) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, this Trade Act also requires agencies to consider international standards and, where appropriate, use them as the basis of U.S. standards. And fourth, the Unfunded Mandates Reform Act of 1995 requires agencies to prepare a written assessment of the costs, benefits and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local or tribal governments, in the aggregate, or by the private sector, of $100 million or more annually (adjusted for inflation.)

In conducting these analyses, FAA has determined this proposed rule: 1) would have benefits which do justify its costs, is not a "significant regulatory action" as defined in the Executive Order and is "significant" as defined in DOT's Regulatory Policies and Procedures; 2) would not have a significant impact on a substantial number of small entities; 3) would reduce barriers to international trade; and 4) would not impose an unfunded mandate on state, local, or tribal governments, or on the private sector. These analyses, available in the docket, are summarized below.

Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) of 1980, (5 U.S.C. 601 et seq.) directs the FAA to fit regulatory requirements to the scale of the business, organizations, and governmental jurisdictions subject to the regulation. We are required to evaluate whether a proposed or final action will have a significant impact on a substantial number of "small entities" as defined by the Act. If we find that the action will have a significant impact, we must do a "regulatory flexibility analysis."

[APO to provide analysis here.]

Trade Impact Assessment

The Trade Agreement Act of 1979 prohibits Federal agencies from engaging in any standards or related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and where appropriate, that they be the basis for U.S. standards. In addition, consistent with the Administration's belief in the general superiority and desirability of free trade, it is the policy of the Administration to remove or diminish to the extent feasible, barriers to international trade, including both barriers affecting the export of American goods and services to foreign countries and barriers affecting the import of foreign goods and services into the United States.

In accordance with the above statute and policy, the FAA has assessed the potential effect of this document and has determined that it will impose the same costs on domestic and international entities and thus has a neutral trade impact.

Regulations Affecting Interstate Aviation in Alaska

Section 1205 of the FAA Reauthorization Act of 1996 (110 Stat. 3213) requires the Administrator, when modifying regulations in title 14 of the CFR in manner affecting interstate aviation in Alaska, to consider the extent to which Alaska is not served by transportation modes other than aviation, and to establish such regulatory distinctions as he or she considers appropriate. Because this proposed rule would apply to the certification of future designs of transport category airplanes and their subsequent operation, it could, if adopted, affect interstate aviation in Alaska. The FAA therefore specifically requests comments on whether there is justification for applying the proposed rule differently in interstate operations in Alaska.

Unfunded Mandates Assessment

The Unfunded Mandates Reform Act of 1995 (the Act), enacted as Pub. L. 104-4 on March 22, 1995, is intended, among other things, to curb the practice of imposing unfunded Federal mandates on State, local, and tribal governments. Title II of the Act requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in a $100 million or more expenditure (adjusted annually for inflation) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a "significant regulatory action."

[APO to supply this information:] This notice does not contain such a mandate. Therefore, the requirements of Title II of the Unfunded Mandates Reform Act of 1995 do not apply.

Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism. We determined that this action would not have a substantial direct effect on the States, on the relationship between the national Government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, we determined that this notice of proposed rulemaking would not have federalism implications.

Environmental Analysis

FAA Order 1050.1D defines FAA actions that may be categorically excluded from preparation of a National Environmental Policy Act (NEPA) environmental impact statement. In accordance with FAA Order 1050.1D, appendix 4, paragraph 4(j), this proposed rulemaking action qualifies for a categorical exclusion.

Energy Impact

The energy impact of the NPRM has been assessed in accordance with the Energy Policy and Conservation Act (EPCA) Pub. L. 94-163, as amended (42 U.S.C. 6362) and FAA Order 1053.1. It has been determined that the NPRM is not a major regulatory action under the provisions of the EPCA.

List of Subjects in 14 CFR part 25

Air transportation, Aircraft, Aviation safety, Safety.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend part 25 of Title 14, Code of Federal Regulations, as follows:

PART 25 - AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701-44702, and 44704

2. Amend § 25.901 by revising paragraph (c) to read as follows:

§ 25.901. Installation.

* * * * *

(c) The powerplant installation must comply with the requirements of § 25.1309, except that the effects of the following on the airplane and it's occupants need not comply with § 25.1309(b):

(1) Engine case burn through or rupture;

(2) Uncontained engine rotor failure; and

(3) Propeller debris release.

3. Amend § 25.1301 by revising paragraphs (b)and (c) as follows, and by removing paragraph (d):

a. In paragraph (b), add the word “and” after the semicolon at the end of the phrase.

b. In paragraph (c), change the semicolon to a period, and remove the word “and” at the end of the sentence.

c. Remove paragraph (d).

4. Amend § 25.1309 by revising the text to read as follows:

§ 25.1309. Equipment, systems, and installations

The requirements of this section, except as identified below, are applicable, in addition to specific design requirements of ***Part 25***, to any equipment or system as installed in the ***airplane***. Although this section does not apply to the performance and flight characteristic requirements of Subpart B and the structural requirements of Subparts C and D, it does apply to any system on which compliance with any of those requirements is dependent. ***Jams of flight control surfaces or pilot controls covered by § 25.671(c)(3)*** are excepted from the requirements of 25.1309(b)(1)(ii). ***Single*** failures ***covered by*** 25.735(b)(1) are excepted from the requirements of 25.1309(b). The failure effects ***covered by*** 25.810(a)(1)(v) and 25.812 are excepted from the requirements of 25.1309(b). The requirements of 25.1309(b) apply to powerplant installations as covered by 25.901(c).

(a) The airplane equipment and systems must be designed and installed so that:

(1) Those required for type certification or by operating rules, or whose improper functioning would reduce safety, perform as intended under the airplane operating and environmental conditions.

(2) Other equipment and systems do not adversely affect the safety of the airplane or its occupants, or the proper functioning of those covered by sub-paragraph (a)(1) of this paragraph.

(b) The airplane systems and associated components, considered separately and in relation to other systems, must be designed ***and installed*** so that:

(1) ***Each*** catastrophic failure condition
(i) is extremely improbable; and
(ii) does not result from a single failure; and

(2) ***Each*** hazardous failure condition is extremely remote; and

(3) ***Each*** major failure condition is remote.

(c) Information concerning unsafe system operating conditions must be provided to the crew to enable them to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. Systems and controls, including indications and annunciations must be designed to minimize crew errors which could create additional hazards.

5.  e following section has been addressed by a separate fast track rulemaking package as proposed by the Electrical Systems Harmonization Working Group and TAEIG (reference December 5-6, 2000 TAIEG meeting). New Section 25.1310 is proposed to read as follows:

§ 25.1310 Power source capacity and distribution.

(a) Each installation whose functioning is required for type certification or by operating rules, and that requires a power supply, is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations:

(1) Loads connected to the system with the system functioning normally.

(2) Essential loads, after failure of any one prime mover, power converter, or energy storage device.

(3) Essential loads after failure of --

(i) Any one engine on two-engine airplanes; and

(ii) Any two engines on three-or-more-engine airplanes.

(4) Essential loads for which an alternate source of power is required, after any failure or malfunction in any one power supply system, distribution system, or other utilization system.

(b) In showing compliance with paragraphs (a)(2) and (a)(3) of this section, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operation authorized. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with three or more engines.

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